crystallizing at least a surface layer of the thin film by supplying high energy through an introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere of at least atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least atmospheric pressure, wherein:

#9 cont'D.

crystallization is carried out in a high energy supply apparatus including a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has the introduction window provided in a portion of the wall of the supply chamber, for introducing the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

when a first position of the thin film is irradiated with the high energy introduced into the supply chamber, part of the high energy enters the thin film; and another part of the high energy is reflected by the thin film to form reflected energy that irradiates a second position of the thin film through a course change of the reflected energy.

REMARKS

Claims 1, 2, and 4-63 are pending. Claims 19, 24, 29, 34, 39, 44, 45 and 50-55 have been previously withdrawn from consideration. By this Supplemental Amendment, claims 1, 12, 20, 25, 30, 35, 40, 46 and 56 are further amended to recite that the hydrogen-containing atmosphere is of at least atmospheric pressure. Reconsideration based on the above amendments and following remarks is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Applicants thank Examiner Rao for the courtesies extended to Applicants' representative during the January 9 and 14 telephone interviews. The substance of the telephone interviews is incorporated into the remarks below.

I. The Claims Define Allowable Subject Matter

The Office Action rejects claims 1, 2, 4-18, 21-23, 25-28, 30-33 and 35-38 under 35 U.S.C. §103(a) over U.S. Patent 5,329,207 to Cathey et al. and U.S. Patent 5,200,630 to Nakamura et al.; and claims 40-43, 46-49 and 56-63 under 35 U.S.C. §103(a) over Cathey et al., Nakamura et al. and further in view of JP A 58-090722 to Sato. These rejections are respectfully traversed.

As discussed during the interview, the applied references do not teach, disclose or suggest "crystallizing at least a surface layer of the thin film by applying energy to a window that exhibits transparency to the energy to the surface of the thin film, wherein a distance between the window and the thin film is more than about twenty mm, and at least the surface layer of the thin film is melted by the applied energy and crystallized by cooling solidification under a hydrogen-containing atmosphere of at least atmospheric pressure," as recited as recited in claim 1, and as similarly recited in claims 12, 20, 25, 30, 35, 40, 46 and 56.

The specification at page 13, lines 28-30, discloses that the total pressure is preferably atmospheric pressure or higher. In most cases, for crystallization, the specification discloses that the inside of the chamber is held at the atmospheric pressure or at a slightly higher pressure. The atmospheric pressure refers to the outside atmospheric pressure of the chamber. Thus, the recited claim feature is supported by the specification.

During the telephone interview, U.S. Patent No. 5,403,772 to Zhang et al. was asserted as reading on the recited claim feature. Applicants respectfully traverse this assertion.

Zhang et al. merely discloses at col. 12, lines 15-18 that the amorphous silicon film 1 is fabricated by a plasma CVD method or vacuum CVD method. Zhang et al. does not teach, disclose or suggest a hydrogen-containing atmosphere of at least atmospheric pressure as

claimed. Rather, the disclosure of plasma or vacuum CVD suggests either a vacuum or near-vacuum controlled-pressure environment.

Furthermore, as earlier traversed in the Amendment Under 37 C.F.R. §1.114, filed March 26, 2001, Zhang et al. does not teach, disclose or suggest "forming a thin film having a surface on a substrate"; and "crystallizing at least a surface layer of the thin film by applying energy to the surface of the thin film, ... at least the surface layer of the thin film is melted by the applied energy and crystallized by cooling solidification under a hydrogen-containing atmosphere", and "wherein unpaired bonding electrons on the surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere", as recited in claim 1, and as similarly recited in claims 12, 20, 25, 30, 35, 40, 46 and 56.

For at least these reasons, the combination of Cathey et al. and Nakamura et al. does not render obvious the subject matter of claims 1, 2, 4-18, 21-23, 25-28, 30-33 and 35-38 under 35 U.S.C. §103(a); and the combination of Cathey et al., Nakamura et al. and Sato does not render obvious the subject matter of claims 40-43, 46-49 and 56-63 under 35 U.S.C. §103(a). Withdrawal of the rejections of claims 1, 2, 4-18, 21-23, 25-28, 30-33 and 35-38 under 35 U.S.C. §103(a) over Cathey et al. and Nakamura et al.; and claims 40-43, 46-49 and 56-63 under 35 U.S.C. §103(a) over Cathey et al., Nakamura et al. and further in view of Sato is respectfully requested.

II. Conclusion

For at least these reasons, it is respectfully submitted that this application is in condition for allowance. Reconsideration of the application is requested.

Should the Examiner believe anything further is desirable to place this application in even better condition for allowance the Examiner is invited to contact Applicants' undersigned representative at the telephone number listed below.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Richard J. Kim
Registration No. 48,360

JAO:RJK/mdw

Attachment:
Appendix

Date: January 31, 2003

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

Spoke with Richard J. Kim's secretary @ 4pm on 2/26/03. Debra McCoo.

APPENDIX

Changes to Claims:

The following is a marked-up version of the amended claims:

1. (Seven Times Amended) A method of forming a crystalline film, comprising:

forming a thin film having a surface on a glass substrate; and

crystallizing at least a surface layer of the thin film by applying energy through a window that exhibits transparency to the energy to the surface of the thin film, wherein a distance between the window and the thin film is more than about 20 mm, and at least the surface layer of the thin film is melted by the applied energy and crystallized by cooling solidification under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure,

wherein unpaired bonding electrons on the surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure.

12. (Seven Times Amended) The method of forming a crystalline film, comprising:

forming a semiconductor thin film having a surface on a glass substrate; and

crystallizing at least a surface layer of the semiconductor thin film by applying energy through a window that exhibits transparency to the energy to the surface of the semiconductor thin film, wherein a distance between the window and the thin film is more than about 20 mm, and at least the surface layer of the semiconductor thin film is melted by the applied energy and crystallized by cooling solidification under an atmosphere of at least ~~or approximate~~ atmospheric pressure containing a gas containing the component element of the semiconductor thin film and hydrogen,

wherein unpaired bonding electrons on the surface of the semiconductor thin film during the cooling solidification are terminated by hydrogen atoms in the atmosphere of at least ~~or approximate~~ atmospheric pressure.

20. (Eight Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

setting the thin film in a supply chamber of a high energy supply apparatus including a generation source for generating the high energy and the supply chamber for supplying the high energy to the thin film, the supply chamber including an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber;

crystallizing at least a surface layer of the thin film by supplying high energy through the introduction window to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film being melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification being terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure; and

positioning the introduction window relative to the thin film at a location resistant to adherence of components of the thin film when the high energy is supplied to the thin film such that a distance between the introduction window and the thin film is more than about 20 mm.

25. (Eight Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

setting the thin film in a supply chamber of a high energy supply apparatus including a generation source for generating the high energy and the supply chamber for supplying the high energy to the thin film, the supply chamber including a wall and an introduction window provided in a portion of the wall, the introduction window introducing the high energy into the chamber;

crystallizing at least a surface layer of the thin film by supplying high energy through the introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film being melted by the high energy and crystallized by cooling solidification, and unpaired

bonding electrons on a surface of the thin film during the cooling solidification being terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure; and

positioning the introduction window relative to the thin film so that a distance between the introduction window and the thin film is larger than about 20 mm.

30. (Seven Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by

cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and a supply chamber for a supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm; and

the high energy is supplied to the thin film under a pressure in the vicinity of the introduction window that is higher than a pressure in the vicinity of the thin film in the supply chamber.

35. (Seven Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm, and an exhaust port for exhausting air in the supply chamber; and

the high energy is supplied to the thin film under (i) a pressure in the vicinity of the introduction window that is higher than a pressure in the vicinity of the thin film, and (ii) a pressure in the vicinity of the thin film that is higher than a pressure in a vicinity of the exhaust port in the supply chamber.

40. (Seven Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate;

crystallizing at least a surface layer of the thin film by supplying high energy to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, wherein:

crystallizing is carried out in a high energy supply apparatus which includes a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber includes an introduction window that exhibits transparency to the energy and introduces the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window along an irradiation path in the supply chamber;

a part of the high energy enters the thin film, and another part of the high energy is reflected from the thin film along a reflection path in the supply chamber;

a gas flow is present in the supply chamber; and

the high energy is supplied to the thin film with (i) the gas flow from the introduction window to the thin film in approximately the same direction as the irradiation path, and (ii) the gas flow from the thin film in approximately the same direction as the reflection path.

46. (Eight Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy through an introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, wherein:

crystallization is carried out in a high energy supply apparatus that includes a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has the introduction window provided in a portion of the wall of the supply chamber, for introducing the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

the thin film is irradiated with the high energy introduced into the supply chamber through the introduction window, the high energy passes through the introduction window along an irradiation path and travels along the irradiation path in the supply chamber; and

the high energy is supplied to the thin film with the normal direction of the thin film shifted by an angle from the direction of the irradiation path.

56. (Seven Times Amended) A method of forming a crystalline film, comprising:

forming a thin film on a glass substrate; and

crystallizing at least a surface layer of the thin film by supplying high energy through an introduction window that exhibits transparency to the energy to the thin film under a hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, at least the surface layer of the thin film is melted by the high energy and crystallized by cooling solidification, and unpaired bonding electrons on a surface of the thin film during the cooling solidification are terminated by hydrogen atoms in the hydrogen-containing atmosphere of at least ~~or approximate~~ atmospheric pressure, wherein:

crystallization is carried out in a high energy supply apparatus including a generation source for generating the high energy and a supply chamber for supplying the high energy to the thin film;

the thin film is set in the supply chamber;

the supply chamber has the introduction window provided in a portion of the wall of the supply chamber, for introducing the high energy into the supply chamber, wherein a distance between the introduction window and the thin film is more than about 20 mm;

when a first position of the thin film is irradiated with the high energy introduced into the supply chamber, part of the high energy enters the thin film; and another part of the high energy is reflected by the thin film to form reflected energy that irradiates a second position of the thin film through a course change of the reflected energy.